

method, which he believes may with good success be adopted upon many occasions, both in new and in old buildings; and he intends to put it into practice upon an early occasion: this is by supporting all the chief super-incumbent weight by a strong arch of brickwork, or of masonry, semi-circular or Gothic as the case may require (but the latter always if the work is to be covered with stone, and in old buildings); in this, as in the last-described method, shoring is nearly if not entirely superseded; and if address and care be used, no fracture will occur. The mode to be adopted, is first to fix the story-posts of iron; then to proceed to mark out the great arch, which may be inserted bit by bit (without endangering the fabric), till the whole is complete.* The tie across may be made very light, according to circumstances, and sometimes so as merely to be sufficient to hold the story-posts from being driven apart; and in lieu of a breast-summer, may be inserted one or several such assemblages of work as are described in § 542. —From *Decline of Excellence in the Structure and Science of Modern English Building*. By Alfred Bartholomew, Esq., F.S.A., Architect, Professor of Carpentry to the Free-Masons of the Church.

WESTMINSTER BRIDGE.

THE *Times* newspaper has published the subjoined remarks upon this structure:—

The late state of Westminster-bridge has excited, not without reason, a good deal of interest in the public. That interest has almost terminated in alarm and the apprehension of the destruction of the edifice, from the rumours that have arisen about what is going on, and the somewhat tremendous appearance of the excavations into the very body of the fabric, which have been partly seen through the hoarding by which the footpath is confined, and at the ends of the hoarding at those points where the foot passengers cross from one side of the foot pavement of the bridge to the other. To attach blame to any person or persons to whom the reparation of the bridge has been intrusted, would be injurious, and, as far as we can at present judge, unjust.

It would require a very complete knowledge of engineering and of the science of bridge-building, together with a very minute inspection of all that has been done and is still being done at this bridge, to enable any one to give a decisive opinion of the labours of Messrs. Walker and Burgess; and it would be a piece of very impertinent presumption on the part of anybody not practically and intimately acquainted with all the details and difficulties of the proceedings and processes either to condemn or praise. As far as we can form an opinion, these gentlemen have done all in their power to remedy the defects of a bridge, which, we believe, it is admitted was from the time of its original construction by Labeley, nearly 100 years ago, understood to be defective in its foundation, or at least so balanced on its foundation, as to be extremely susceptible of danger from any alterations in the bed of the river, or from any cause by which an alteration could be effected upon its pressure. The report presented by Messrs. Walker and Burgess to the Speaker of the House of Commons last summer, and which is reprinted below, will explain what it was the business of these gentlemen to perform, and also some other matters by which the public may partly judge of what will be the state and appearance of the bridge when the repairs shall be complete, and the whole of what has been proposed carried out.

In the mean time, a few words as to what was, until Saturday last, the state and situation of that part of the bridge by which the alarm has been caused will be of interest. The pier, called, we believe, the "seventeen-foot east pier," has been repaired and widened. Its pressure on the bed of the river was found to be at the rate of five tons and a half to a square foot, and it was found that the timbers of the original caisson, which were very much decayed, had been on the edges of the stone work of the pier forced out of their horizontal position, and bent and broken upwards by the enormous weight. The engineers, amongst

other means to remedy this defect, enclosed the whole of the lower portion of the pier with sheet piling, driven seven feet into the clay of the bed of the river, and made watertight by the closeness of the piles one to the other. Between the piles and the pier stone-work closely cemented was introduced, and the work was submitted to the judgment of those who were considered competent to form an opinion, and who gave an opinion that the means adopted were the best that were available. Nevertheless, the pier began or continued to sink, and danger was apprehended for the fate of the arch which it supported. The plan adopted to prevent such a catastrophe, and which it is hoped will prove successful, was this:—the pavement of the bridge was taken up, and the immense mass of Kentish ragstone, cement, &c., composing a concrete, and weighing upon the pier 2,400 tons, was removed from the spandril of the arch. Since this has been done, the pier has remained firm, and the settling of the foundation appears to have ceased. The concrete has since been removed from the spandrils of all the arches, and, in the place of a solid mass, brick arches have been substituted between the spandrils, by which nearly a third of the weight of the bridge will be removed, and the consequent pressure of the pier on the clay bed of the river relieved. The enormous weight of the balustrade and the heavy recesses will be removed, by which a further reduction of weight will be obtained, and the future projected ornamental alterations facilitated. This will, of course, be a work of some time; but if the bridge be ultimately rendered secure and more slightly then at present, nobody will be much inclined to find fault with what is a temporary yet necessary obstruction to passengers.

The following is the

"REPORT TO THE SPEAKER, BY MESSRS. WALKER AND BURGESS, ON THE ALTERATIONS PROPOSED BY MR. HARRY.

Sir,—As that portion of Mr. Barry's report to his Royal Highness Prince Albert (on the decorations, additions, and local improvements connected with the new Houses of Parliament) which refers to Westminster-bridge may naturally lead to the opinion that our plans, made under the direction of the bridge Commissioners, were confined to the repairing and extending of the foundations, for our superintendence of which be kindly compliments us; we consider it therefore a duty to prevent such a mistake, by stating, that the designs, estimates, and the original contract with Mr. Cubitt, included the repair of every part of the bridge, the removal of the present steep and dangerous inclivities, and the lowering of the parapet and roadway to the lowest possible level* that appeared at the time to be consistent with the safety of the present arches. The second contract with Mr. Cubitt is for lengthening the piers, which are being carried to above high-water level, to receive arches for widening the bridge 12 feet. It will then be of the same width as London-bridge. All, in fact, that we have done to Blackfriars-bridge is designed and contracted for to be done to this bridge, with the very important addition of the preparation for widening. The steepest part of Westminster-bridge is the light, when the designs are executed, be as easy as that of Blackfriars-bridge. That which rises 1 in 14 will be reduced to 1 in 24, and even this rise will be for only a limited length.

"To secure the foundations, which were in danger of being undermined by the accretion consequent on the removal of Old London-bridge, has been the first object. The supposed difficulty of doing so effectually was increased by the opinion entertained by Labeley, the original engineer, and others since his time, that, owing to quicksands, coffer-dams could not be applied; and the Commissioners have been desirous of removing all doubts on this point before proceeding with the spandrils, roadway, or parapet. Five out of the seven coffer-dams have been built; so far, we have been completely successful: and while the water was excluded, all the work which was required in repairing and lengthening the piers to above high-water has been done; 7 out of the 13 arches have also been repaired, as the coffer-dams gave facility for the scaffolding necessary for doing this. Thus far, therefore,

our design proposed to, and approved by, the Commissioners, corresponds with, and has anticipated, Mr. Barry's; but the idea of taking down the present semi-circular, for the purpose of substituting pointed arches upon the same foundations, is not ours; and we beg to state shortly why we do not concur in the expediency of this proposal.

"Mr. Barry's first argument for this change is, 'that the pointed arch will enable the road to be lowered, by materially reducing the thickness of the crown of the arches within what is considered necessary for arches of a circular form.' Now, we consider that the whole thickness of the stone-work and covering of the present centre arch may be reduced to about seven feet, which is the same thickness as Mr. Barry's ribs, arch, and covering, measured upon his section; so that, even supposing the principle be states, of the pointed arch requiring less thickness than the circular arch, to be correct, he obtains no reduction in thickness, and only lowers the roadway, by lowering the soffit of the arch. The generally approved theory of arches is, however, directly at variance with Mr. Barry's. In *Pratt's Mathematical Principles of Mechanical Philosophy*—considered a standard work, and, as we are informed, a text-book at Cambridge—the theory is so clearly explained, that we give it in his own words:—"A pointed arch," he says, "must have a great pressure on its crown, to prevent its falling, because it may be considered as consisting of two extreme portions of a very large circular arch brought together, so that the pressure on the crown must at least equal the pressure of the portion of the circular arch which is removed. Flying buttresses always have a great pressure upon their highest part. The pointed arch will sustain almost any weight on its crown, provided the lower stones do not give way, and, consequently, the Gothic arch is stronger for lofty buildings than the circular; but the circular arch is far better adapted than the Gothic arch for bridges, since the pressure of weights passing over may act upon any part of the arch, not only on the crown." Mr. Whewell comes, in different words, to the same conclusion; and the same can be deduced from Atwood, though not so clearly expressed. These are no man authorities; indeed, we do not know an exception in any author, British or foreign, to the opinion, that the pointed arch requires a greater thickness of material at the crown than the circular arch to keep it from rising; and if so, the substitution of the pointed arch should, in place of allowing a reduction, demand an addition to the least thickness required for the present arches. Add to theory, the experience of every modern engineer of this or other countries, as shown in their bridges of any considerable size: for we are not aware of any example of a pointed arch for a bridge of any magnitude in the works of Buseton, Reaite, Telford, Perronet, or indeed of any other.

"Mr. Barry's second argument for substituting the pointed arch, is 'the elevation of its springing above the level of high-water, by which the water-way of the bridge will be the same at all times of tide, in place of being contracted by the present spandrils at high-water nearly equal to 1-20th of its sectional area, occasioning currents, with a fall, and sometimes danger to craft in passing through the bridge under the influence of high winds.' Mr. Barry appears here to have mistaken sectional area, when he must have meant 'width or chord'; for we find that in the section of his scheme, the contraction of the middle arch by the spandrils is about 1-20th of the width at the level of Trinity high water; but as the contraction is only a few feet in depth before the arch falls into the vertical line of the pier, the diminution of sectional area is not 1-20th, nor more than 1-120th, and this at high water only; and even this small diminution is in effect reduced practically to nothing as respects the current, when it is considered that the greatest velocity does not take place until half ebb, by which time the water has sunk below the level of the spandril. It is, we think, therefore evident, that the proposed alteration will not produce any useful effect upon the currents or the falls. When the bed of the river under the arches is lowered (which also is part of the contract), and the coffer-dams removed, the present current through the bridge will be materially lessened. Some

* The author has several times adopted the method above stated of inserting such an old wall without shoring, and he has done so lately at his own residence. Since writing the above, he has been told that the same method was pursued in an alteration to a new church in the Regent's park, London; but this method, so simple and obvious, he never heard of before he procured it himself.

"The Commissioners have power to suspend or suspend the contract in respect of any works not commenced."